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THE PARIETAL AREA

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IN two recent papers,^{1, 2} the writer has advanced some new views on the anatomy and development of the parietal and post-central areas of man. These views are based on the modern conception of the origin and cause of the cerebral sulci put forward by Elliot Smith. A brief account of this work of the last named will be found in the new Cunningham's "Text-Book of Anatomy," and especially in the paper by him referred to below.

Difference of structure of the various parts of the cortex is the principal factor in the causation of sulci. And with this difference of structure we may assume a difference of function. From this we may argue that as we trace the mammalian scale upwards we shall find that with evolution new sulci will appear to limit or infold the cortical areas with which the newly acquired functions are associated. There can be few functions, however, that are totally unrepresented on even the lowest brains. So that what probably happens in the anthropoids is this: the very high development of those cortical areas which are represented but slightly in the lowest animals. In such cases some of the apparently new sulci of the former will be merely exaggerations of slight puckerings on the cortex of the latter, whilst the remaining sulci will be quite new, being due to a differentiation of which there is no trace in lower brains.

Since the cerebral sulci are called into being by the specialisation of the cortex into areas, it follows that the sulci will be identical in different brains only if the structure of the brains is identically the same. It is the slight difference of structure, with the corresponding slight differences in the shape and disposition of the sulci, that causes brains to be so different in appearance, even though belonging to animals of the same species. The more highly evolved any two brains are, the more dissimilar will they be; for now cortical specialisation will be reaching its highest

¹ "The Morphology of the Sulcus Interparietalis, B.N.A.," *Journal of Anatomy*, July 1913.

² "A Note on the Sulcus Post-centralis Superior," *Anatomischer Anzeiger*, 1913, xliv.

forms, and the newer the area the more liable it is to slight variation. In the second paper, referred to above, the writer has stated: "I am fully aware that the sulci cannot be taken as the rigid boundaries of specialised areas, as was pointed out long ago by Sherrington. But at the same time, I cannot conceive of sulci being far removed from such boundaries, seeing that it was specialisation of cortex which produced them."

The more primitive a sulcus is, and the more primitive the area which it limits, then the more constant in position and shape does it appear to be, though it may often be modified or obscured by the confluence of newer sulci produced by the more recently specialised areas. On the most primitive brains the sulci which either limit or are infolded in the areas differentiated for locomotion and general and special sensation are the only outstanding furrows. On the anthropoid brains these furrows are much less salient; their outlines are obscured by the appearance of a vast number of sulci which have arisen with the new areas which are characteristic of the higher brains. To take an example: Evidence is adduced in the papers above referred to, for believing that the parietal association area with the characteristic furrows crossing it appears for the first time in the anthropoids, and is not present in animals lower than they. This area widely separates the areas of vision and common sensation from one another, and its most characteristic feature in man is the great development of its lower part, *i.e.*, the angular and supra-marginal gyri. The rudiment of a parietal area is present in apes as low as *pitheciæ*, but it is not at all similar in structure to that of man. In the latter it consists most characteristically of four structurally different quadrants. These are separated from one another by the furrows which their differentiation has produced. Thus, the separation of the area into upper and lower portions of different structure gives rise to the sulcus parietalis horizontalis (ramus horizontalis of the intraparietal sulcus of Turner in the old terminology). Then the differentiation of each upper and lower portion into anterior and posterior structurally different areas, leads to the formation of the superior and inferior parietal sulci, which are, of course, vertically directed. It seems likely that the changes in the lower parietal area occur later in evolution than those in the upper. For the *pitheciæ* have a parietal cortex, small though it is, which somewhat resembles that of the superior parietal cortex of man. But

they have nothing comparable with the structure of the angular and supra-marginal gyri (lower parietal lobule).

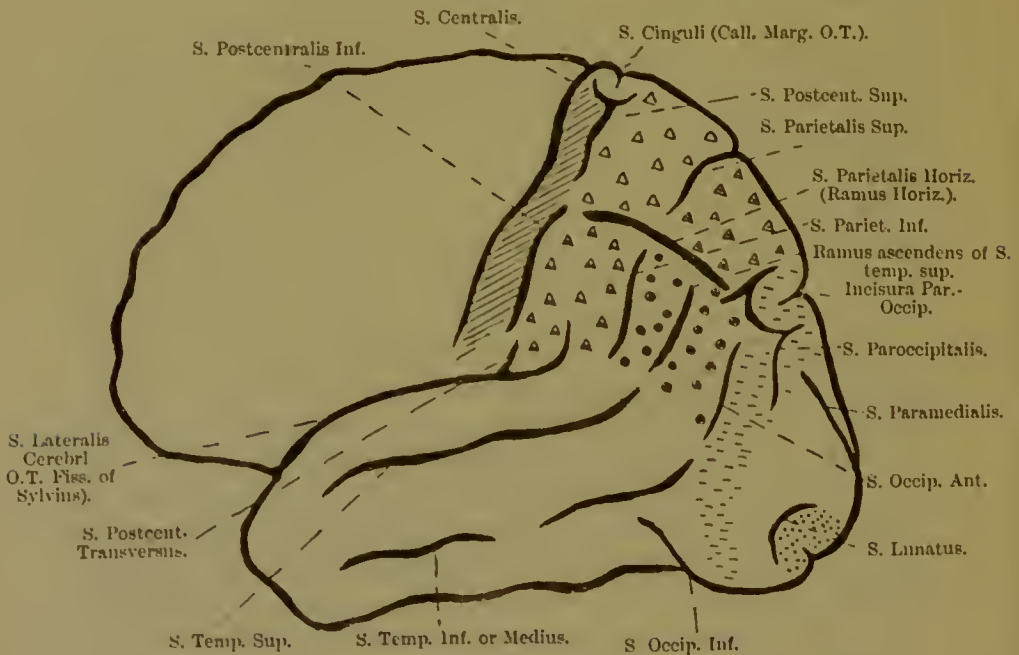
It will be realised from the foregoing remarks that the typical parietal furrows can only appear in animals whose cortical structure resembles that of man. Thus, no sulcus parietalis horizontalis can arise until the parietal field is differentiated into upper and lower portions. So that homologues between the parietal furrows of man and those say of cercopithecus whose parietal cortex is of uniform structure cannot truly be found. Yet the more horizontal part of the oblique furrow on the retro-central cortex of the last named is commonly urged to be homologous with the sulcus parietalis horizontalis of man. Which is absurd. For everything points to the sulcus parietalis horizontalis being a new furrow in the anthropoids, in whom for the first time there is a specialisation of the parietal area into upper and lower fields.

The sulcus parietalis horizontalis is frequently superficially confluent with the sulcus post-centralis inferior. Each of these furrows has a separate cause and origin, but as cortical development proceeds, the two tend to run into one another. This confluence has led anatomists to regard these two really perfectly independent sulci as parts of a system of furrows to which the name "Intraparietal sulcus of Turner" has been given. This system is completed by the addition to it of Wilder's sulcus paroccipitalis. The whole thus well merits Eberstaller's epithet of Furchen conglomerat. Such a grouping together of furrows can only lead to confusion. In the papers referred to, the individuality of each sulcus has been insisted upon and the simple names already alluded to applied to each—this in the hope of a speedier recognition of their nature and origin.

There is one further point not referred to previously. There are three arching gyri in this region commonly described in anatomical text-books as belonging to the inferior parietal area. These are the supra-marginal, angular, and post-parietal gyri, and they are said to be wound around the upturned ends of the lateral fissure (Sylvius), the superior temporal, and the middle temporal sulcus respectively.

There is some excuse for retaining the terms supra-marginal and angular gyri as they do actually correspond to definite areas, *i.e.*, the anterior and posterior inferior parietal areas. Each gyrus is

of homogeneous structure throughout its extent. On the other hand, it is quite uncommon to find a well-formed post-parietal gyrus. Usually it is absent. The sulcus that it is said to be thrown around is not the end of the commonly much broken up middle temporal sulcus, but the anterior occipital. This last is a limiting sulcus with a cortex of different structure in front of and behind it. It is obvious, therefore, that the post-parietal can never be as constant as the other two arching gyri for the reason that it could not be homogeneous in structure. The anterior occipital sulcus is the boundary line between the parietal area and



SCHEME OF PARIETAL AREA.

DESCRIPTION OF FIGURE.

Scheme showing how the sulci separate different areas. The s. post-centrales, *sup. et inf.*, separate the general sensory area from the parietal association area, whilst this last is divided into four quadrants by its own special sulci. In the inferior parietal area it will be noted that there are two sulci. Of these, one, the s. pariet. inf., is a *limiting* sulcus separating the anterior and posterior parts of the inferior parietal area, whilst the other, the ramus ascendens of the sup. temporal sulcus, is an *axial* furrow infolded in the area of black triangles. The figures used to denote the different areas have no special significance (after Brodmann).

the peri-striate (Brodmann)¹ or the rather indefinite area parieto-occipitalis (Elliot Smith).² What the true anatomical boundary, if any, of the occipital lobe should be may well be open to argument. But the whole area for vision maps out the arbitrary text-book occipital lobe fairly accurately. At the worst the mapping out of precise boundaries for the occipital lobe is an extremely unimportant point, as it passes into the parietal and temporal lobes without break of surface. If a boundary must be found for it, it should be the limits of the peristriate area of Elliot Smith, visuo-psychic of Bolton and others.

¹ K. Brodmann, "Lokalisation der Grosshirnrinde," *Journ. für Psychologie und Neurologie*, Leipzig, 1906-7.

² Elliot Smith, "New Topographical Survey of Cortex," *Journ. of Anat.*, July 1907.

